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MEĐUNARODNI VETERINARSKI
KONZORCIJUM ZA BIOSIGURNOST
AKVATIČNIH ORGANIZAMA
LUDVIG-MAKSIMILIJAN UNIVERZITET
MINHEN, NEMAČKA

VIII INTERNATIONAL
CONFERENCE

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KONFERENCIJA

WATER & FISH

CONFERENCE
PROCEEDINGS
June 13 - 15, 2018

ZBORNIK
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UNIVERSITY OF BELGRADE, FACULTY OF AGRICULTURE - SERBIA
AND INTERNATIONAL AQUATIC VETERINARY BIOSECURITY CONSORTIUM, LUDWIG-MAXIMILIANS-UNIVERSITY MUNICH, GERMANY

SUPPORTED BY
EUROPEAN AQUACULTURE SOCIETY, EAS
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8th INTERNATIONAL CONFERENCE "WATER & FISH"

CONFERENCE PROCEEDINGS

Faculty of Agriculture, Belgrade-Zemun, Serbia
June, 13 – 15. 2018.

PUBLISHER
University of Belgrade - Faculty of Agriculture

FOR THE PUBLISHER:
Prof. Dr. Milica Petrović

COMPUTER DESIGN
GRAPHIC, Novi Sad

TECHNICAL PREPARATION OF A COVER
Dr. Božidar Rašković

TECHNICAL TEXT PREPARATION
Dr. Ivana Živić

PRINTED BY
GRAPHIC, Novi Sad

NUMBER OF COPIES PRINTED
400 COPIES

ORGANIZATION OF THE CONFERENCE SUPPORTED BY:
Ministry of Education, Science and Technological Development Republic of Serbia

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UNIVERZITET U BEOGRADU, POLJOPRIVREDNI FAKULTET - SRBIJA
I MEĐUNARODNI VETERINARSKI KONZORCIJUM ZA
BIOSIGURNOST AKVATIČNIH ORGANIZAMA,
LUDVIG-MAKSIMILIJAN UNIVERZITETA U MINHENU, NEMAČKA

UZ PODRŠKU
EVROPSKOG DRUŠTVA ZA AKVAKULTURU - EAS
I
PAN-HELENSKOG DRUŠTVA TEHNOLOGA IHTIOLOGA - PASTI

VIII MEĐUNARODNA KONFERENCIJA ”VODA I RIBA”

ZBORNIK PREDAVANJA

Poljoprivredni fakultet, Beograd– Zemun, Srbija
13. – 15. jun, 2018. godine

IZDAVAČ
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THE APPLICATION OF DIATOM INDICES FOR WATER QUALITY ASSESSMENT – CASE STUDY OF JOVAC AND ROČNJAK STREAMS

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UPOTREBA DIJATOMNIH INDEKSA ZA PROCENU KVALITETA VODE – STUDIJA SLUČAJA POTOKA JOVAC I ROČNJAK

Apstrakt

U ovom istraživanju predstavljeni su rezultati analize epilitskih zajednica silikatnih algi iz potoka Jovac i Ročnjak, dve pritoke akumulacije Vrutci. Uzorci su sakupljani mesečno u periodu od decembra 2014. do oktobra 2015. godine. Identifikovano je ukupno 118 taksona silikatnih algi. Najbrojnije populacije u okviru epilitske zajednice silikatnih algi, u oba potoka, grade *Achnanthidium minutissimum* var. *minutissimum* i *Cocconeis placentula* var. *lineata*. Rezultati izračunavanja dijatomnih indeksa, uz pomoć softverskog paketa OMNIDIA, ukazuju da je ekološki status vode oba potoka u ispitivanom periodu dobar, sa veoma niskim organskim opterećenjem i uz odsustvo antropogene eutrofikacije.

Ključne reči: *bentosne silikatne alge, dijatomni indeksi, kvalitet vode, potoci Jovac i Ročnjak*
Keywords: *benthic diatoms, diatom indices, water quality assessment, Jovac stream, Ročnjak stream*

INTRODUCTION

Benthic diatoms are so ecologically important that they are used as bioindicators in water quality assessment (Ács et al. 2004). They have been used in a number of countries as bioindicators of river pollution (Kelly and Whitton 1995, Blanco et al. 2004, Gosselain et al. 2005, Solak 2011). However, in Serbia it is still a new topic (Krizmanić et al. 2013, 2015, Vasiljević et al. 2014, 2017, Jakovljević et al. 2016a, 2016b).

The Jovac and Ročnjak streams, tributaries of the Vrutci accumulation, are located at western part of Serbia. Streams have a torrential character and are built from limestone.

Catchment area is characterized by mountainous and hilly terrain on altitude from 570 to 1250 m.a.s.l. (KRO "Bioktoš" 1986).

The aim of this study is the use of diatom indices as a tool for estimating the stream water quality.

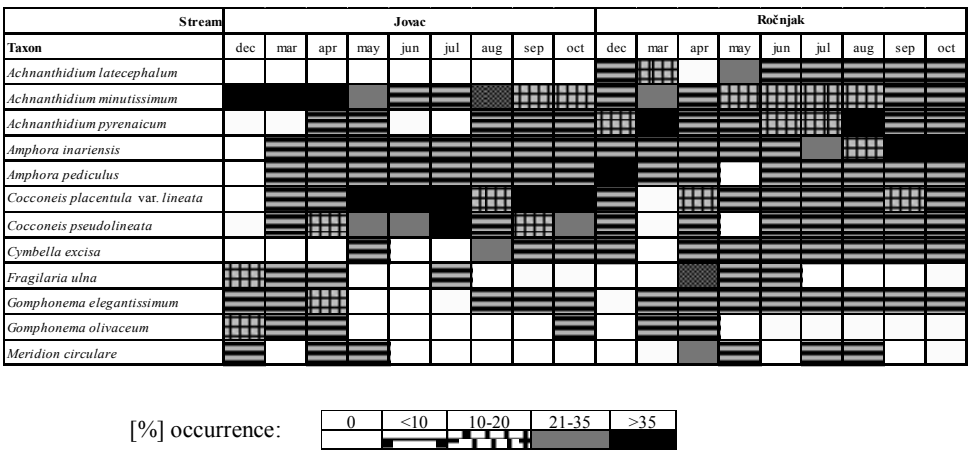
MATERIAL AND METHODS

The material used in the present study was collected between December 2014 and October 2015 from Jovac and Ročnjak streams, tributaries of the Vrutci accumulation. Epilithic samples were scraped from the surface of gravel and boulders by using scalpel blade and brush. *In laboratory the field samples were treated with standard method with cold acid (Krammer and Lange-Bertalot 1986) to prepared permanent slides.* Light microscope observations and micrographs were made using a Zeiss AxioImager.M1 microscope with DIC optics and AxioVision4.8 software. The relative abundance of taxa was estimated by counting 400 valves present on each permanent slide. The biological assessment of water quality was performed by OMNIDIA 5.3 software. The ranges of diatom indices were used together with a water quality classes and ecological status according to the regulation of the Ministry of Environmental Protection (Sl. Glasnik 74/2011).

RESULTS AND DISCUSSION

In this study, a total of 118 diatom taxa were identified, of which 54 are joint taxa for both streams. The most numerous were taxa of the genera *Gomphonema*, *Nitzschia* and *Navicula*. In Jovac stream taxa *Achnanthidium minutissimum* var. *minutissimum* and *Cocconeis placentula* var. *lineata* dominated in epilithic diatom communities of both streams. These two taxa dominate in all months alternately or in combination with some of the other dominant taxa (Tab. 1). These are some of the most common diatoms, with a wide ecological range. They prefer oligo- to eutrophic waters, and develop numerously in mountain streams with no anthropogenic impact (van Damm et al. 1994, Cantonati et al. 2017). In Ročnjak stream, in addition to these two taxa, 6 other taxa were defined as dominant, those whose percentage participation was 10% or more.

Table 1. Dominance in diatom communities in Jovac and Ročnjak streams between December 2014 and October 2015.



Dominant and frequent species identified in the epilithic communities of the Jovac and Ročnjak streams, such as *Achnanthidium pyrenaicum*, *Cocconeis pseudolineata*, *Amphora pediculus* and *A. inariensis*, were also found in other water ecosystems with a good water quality, e.g. Baryczka stream (Noga et al. 2013).

Rivers and streams with a low level of pollution are also characterized by higher species diversity (Kwandrans et al. 1998; Rakowska and Szczepocka 2011), which is the case with Jovac and Ročnjak streams. Further, a substantial part of the diatom species identified in these streams are species that prefer water with low level of pollution, β-mesosaprobic zones, according to indicator values after the OMNIDIA 5.3 database.

In order to determine the water quality of Jovac and Ročnjak streams, 17 diatom indices were counted with OMNIDIA software. IPS and CEE were taken into consideration as legally obliged indices in the assessment of ecological status of rivers in Serbia.

The results of a diatom indices analysis (Tab. 2) in general show the excellent (first class) ecological status of Jovac and Ročnjak streams in the investigated period, with the absence of organic pollution and anthropogenic eutrophication. However, ecological status of Jovac stream in December 2014 for both indices is classified as good (second class). The presence of *Gomphonema olivaceum* and *Fragilaria ulna* with high abundance (Tab. 1) could give explanation in changes of ecological status in December 2014. Those taxa are tolerant to high concentration of nutrients and eutrophic conditions (van Damm et al. 1994).

Table 2. Diatom indices values of Jovac and Ročnjak streams in the investigated period. Blue color – excellent ecological status (first class); green color – good ecological status (second class)

Stream	**Jovac**									**Ročnjak**								
Index	dec	mar	apr	may	jun	jul	aug	sep	oct	dec	mar	apr	may	jun	jul	aug	sep	oct
CEE	13,7	16,2	18,3	19,2	18,5	17,5	18,1	18,9	17,9	17,2	17,7	17,2	17,7	17,7	17,9	17,5	18,1	16,0
IPS	14,6	18,3	18,2	17,4	16,7	17,0	16,4	16,8	17,1	15,9	17,0	16,3	15,8	17,1	17,5	17,0	18,6	17,5

In the Ročnjak stream the values of CEE index were the whole time inside the boundaries of first class, while IPS showed lower ecological status in December 2014 and May 2015. *Amphora pediculus* and *Achnanthidium pyrenaicum* were the most dominant taxa (Tab. 1) in December 2014. Their tolerance on eu- to mesotrophic conditions (van Damm et al. 1994) is clearly reflected in the reduced index value. Bioindicator caracteristics of *A. latecephalum*, the most dominant taxon in May 2015 (Tab. 1), was obtained for IPS index only. Lack of ecological information in OMNIDIA softwer excludes the influence of this taxon on the values of other indices.

According to the Serbian legislations, IPS and CEE indices together leads to the conclusion that both streams have good ecological status and belonged to the second class of water quality.

CONCLUSIONS

A total of 118 diatom taxa were identified in Jovac and Ročnjak streams. The most dominant in taxa were *Cocconeis placentula* var. *lineata* and *Achnanthidium minutissimum* var. *minutissimum*.

Based on the obtained values of diatom indices can be concluded that both streams have no major variations of water quality during the observed period. The water had good

ecological status and belonged to the second class of water quality. Water quality monitoring based on diatom indices is still a new topic in Serbia; and will be getting more improved with new research in the near future.

ACKNOWLEDGMENT

Supported by the Ministry of Education, Science and Technological Development of Republic of Serbia (project numbers TR 37009 and ON 176020).

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CIP - Каталогизација у публикацији
Народна библиотека Србије, Београд

639.2/.3(082)

INTERNATIONAL Conference "Water & Fish" (8 ; 2018 ; Beograd)
Conference Proceedings / 8th International Conference "Water & Fish", Faculty of Agriculture, Belgrade-Zemun, Serbia, June, 13-15. 2018. ; [editors in chief Vesna Poleksić, Božidar Rašković and Zoran Marković]. - Belgrade : University, Faculty of Agriculture, 2018 (Novi Sad : Graphic). - XII, 544 str. : ilustr. ; 23 cm

Tekst na engl. i srp. jeziku. - Na spor. nasl. str.: Zbornik predavanja. - Tiraž 400. - Bibliografija uz svaki rad. - Apstrakti ; Abstracts.

ISBN 978-86-7834-308-7

a) Рибарство - Зборници
COBISS.SR-ID 264387852

ISBN 978-86-7834-308-7